UART/RS232/RS485/USB/Ethernet Over Powerline Narrow Band Communication Transceiver Module

SPYDER

User Manual

July 2011

LinkSprite Technologies, Inc

www.linksprite.com

Doc Title	UART/RS232/RS485/USB/Ethernet Spyder User Manual	**Number**	SPYDER_DATA_ENG1
		Version	1.0

Version	Date	Description	Author
1.0	07/11/2011	V1.0	Nancy

Table of Content

Ⅰ Summary 4
1 Introduction 4
2 Features 5
3 Specifications 6
4 Applications 7
Ⅱ Diagram 8
1 Functional Diagram 8
2 Board Layout 8
3 Switch Description 9
4 LED 9
5 Definition of DIP Pins 9
6 Interface Card Socket Definition and Layout 11
Ⅲ Command Interface 13
1 Command Mode 13
1.1 Enter command mode 13
1.2 Exit command mode 13
2 Arguments and Responses 13
2.1 Arguments and Responses 13
2.2 Commands without Arguments 14
2.3 Modified arguments 14
3 Command List 14
Ⅳ Repeater Function 18
1 Introduction 18
2 Function Setting 19
2.1 Turn on repeater function 19
2.2 Turn off repeater function 19
2.3 Setting Illustration 20
3 Repeater Hops 20
Ⅴ Logic Address 21
1 Logic Address 21
2 Address Setting 22
Ⅵ Application Illustration 23
1 Introduction 23
2 Start of Narrow Band Powerline Communication Transceiver Module . 25

Ⅰ Summary

1 Introduction

This document documents LinkSprite second-generation powerline communication modem. Based on the feedbacks of the first-generation, LinkSprite second-generation powerline communication modem products are consisted of a Spyder motherboard, UART-RS232 daughter board, UART-RS485 daughter board, UART-USB daughter board, and UART-Ethernet daughter board.

On the Spyder motherboard, there is a 20-pin receptacle, users can choose different daughter boards based on the interface needs. This 20-pin receptacle is pin-compatible with Xbee module from Digi (www.digi.com). So a Xbee module can also be used on Spyder, and Spyder will become a powerline communication to Zigbee bridge.

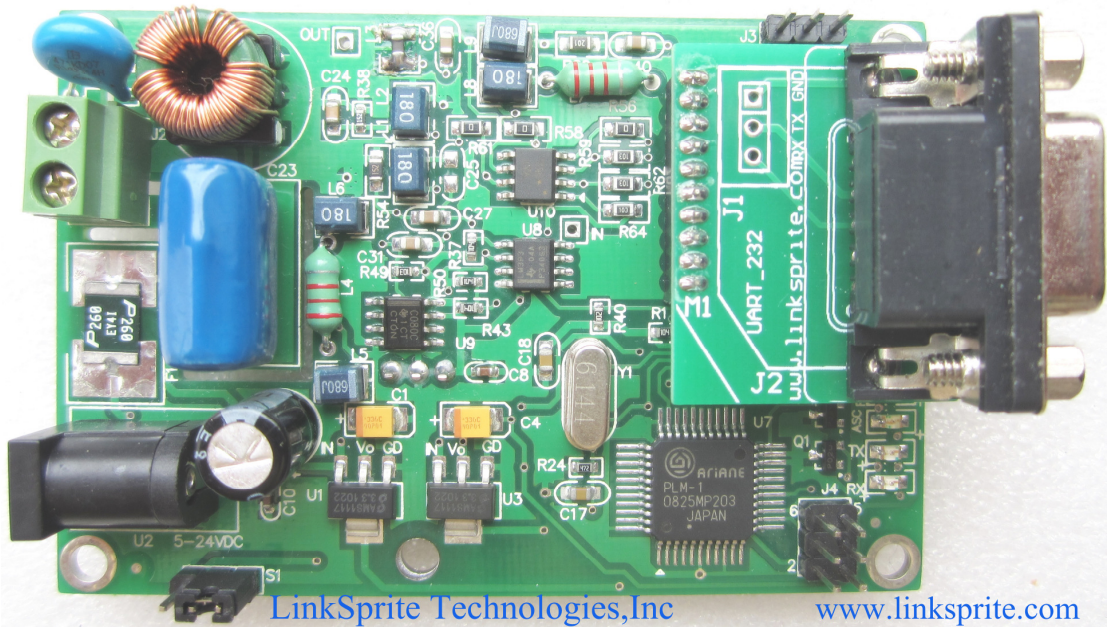
The new generation Spyder motherboard also support DIP by optional pins that can be used to directly plug to user's board without doing screwing. The interface board signals such as RS232/RS485/USB signals are also routed back to motherboard through the 20-pin receptacle, and again to users' board through these DIP pins.

Powerline communication transceiver modules from LinkSprite (LinkSprite modules) are transceiver modules designed to send/receiver serial data over the powerline network. Spyder is designed to transparently move serial data over the powerline network, and achieves the target of replacing cables by the ubiquitous powerline network.

LinkSprite modules have the built-in packet-level repeater function. This feature can greatly extend the coverage of the powerline communication.

LinkSprite module has both physical and logic addresses. In a network, both physical and logic addresses can be used to address different nodes in the network.

2 Features



A Spyder with a UART-RS232 daughter card

- AC and DC powerline Communications
- Fully transparent mode, plug and play coming out of the box without the need to do any programming.
- Built-in error correction codes.
- Built-in repeater function to extend the coverage.
- Physical and logic address
- AT commands used for advanced configuration.
- 3.3V TTL UART, Optional RS232, RS485. USB, Ethernet, Zigbee interfaces
- FSK (Frequency Shift Keying) modulation used in physical layer

- Low power
- RoHS
- Small module size (55mm X 85mm including the on-board power switch regular keep out area), and easy to be implemented into existing products.

3. Specifications

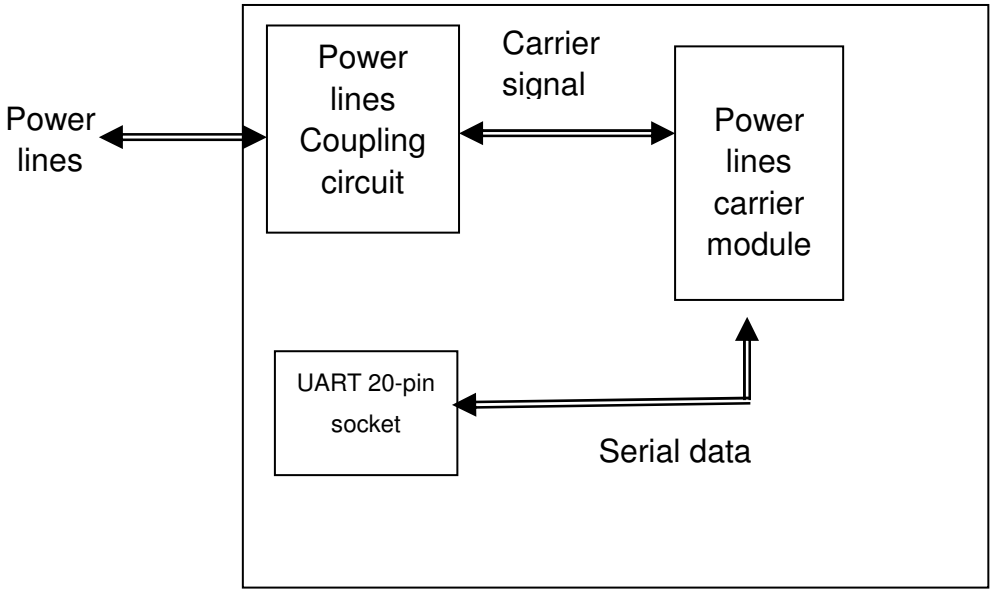
Product name	SPYDER
Interface	3.3V TTL UART Optional interface cards: RS232 (model/ordering no: UART-RS232) RS485 (model/ordering no: UART-RS485) USB (model/ordering no: UART-USB) Ethernet (model/ordering no: UART-Ethernet) Zigbee (model: Xbee from Digi.com)
Communication Line Voltage	230VAC/50Hz 110VAC/60Hz 0-400V DC
Supply Voltages	5V to 24V, 500mA
Modulation	FSK (Frequency Shift Keying)
Carrier frequency	144KHz
Error Correction	FEC (Forward Error Correction)
Data rate on Powerline	2Kbps
Maximum packet data length	300bytes
Repeater Hops	3 Hops
Transmission distance	300 feets（no repeater）
Support nodes number	65535
LED	Power Line Activity LED system LED serial port LED

4 Applications

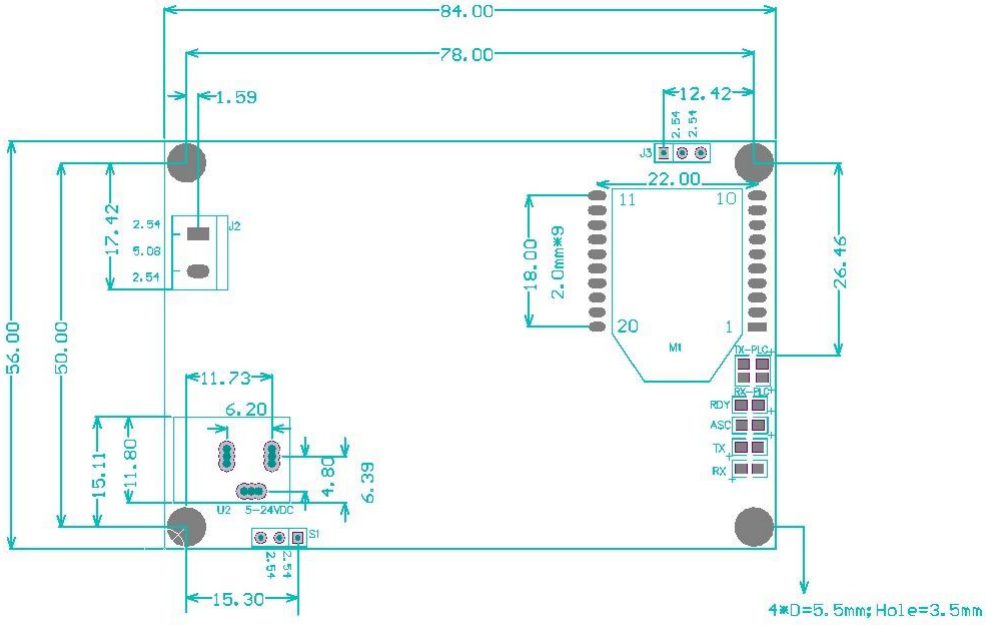
- AMR
- Industry manufacture and control
- Safeguard, fire alarm, smoke alarm
- Collect and transmit instrument data
- Safeguard and monitor
- Home automation
- Solar/Wind electricity generation system

Ⅱ Diagram

1 Functional Diagram



2 Board Layout



3 LED

PLC LED	PLC LED: green mans module is sending data to PLC; red means module is receiving data from PLC
RDY_LED	System LED，green means system is in normal
LED1	Serial port LED，green means module is receiving data from aerial port; red means module is sending data to serial port

4 Definition of DIP Pins

1) Module=X_BEE:

```
J7_1(X1) -> NONE
J7_2(X2) -> NONE
J7_3(X3) -> NONE
J7_4(X4) -> NONE
J6_1(GD) -> GND
J6_2(TX) -> UART_TX  TTL
J6_3(RX) -> UART_RX  TTL
```

2) Module=UART_RS232:

```
J7_1(X1) -> GND
J7_2(X2) -> UART_TX  RS232
J7_3(X3) -> UART_RX  RS232
J7_4(X4) -> NONE
J6_1(GD) -> GND
J6_2(TX) -> UART_TX  TTL
J6_3(RX) -> UART_RX  TTL
```

3) Module=UART_RS485:

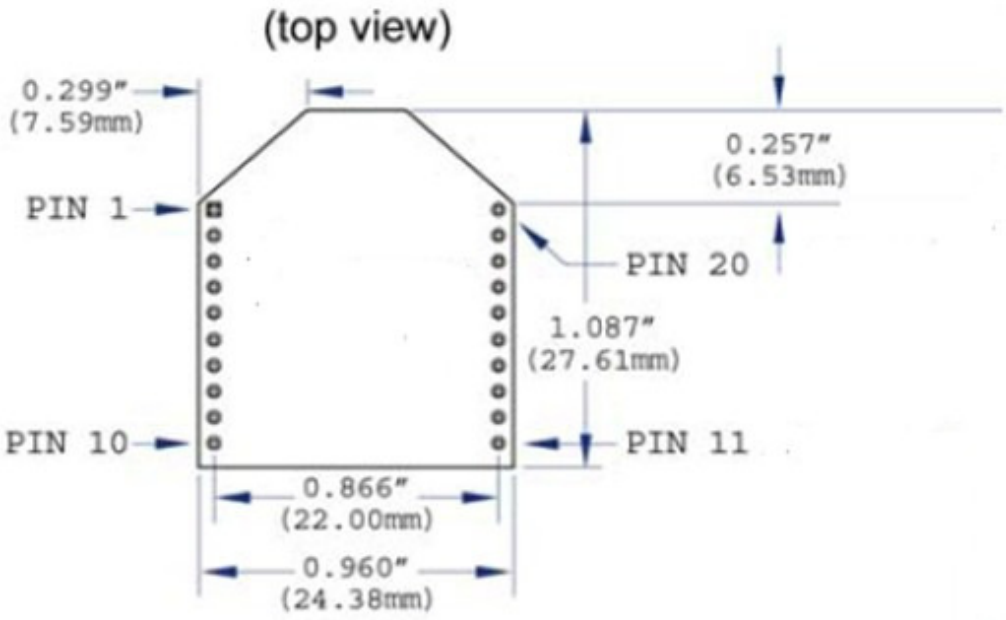
```
J7_1(X1) -> GND
J7_2(X2) -> UART_485_A
J7_3(X3) -> UART_485_B
J7_4(X4) -> NONE
J6_1(GD) -> GND
J6_2(TX) -> UART_TX  TTL
J6_3(RX) -> UART_RX  TTL
```

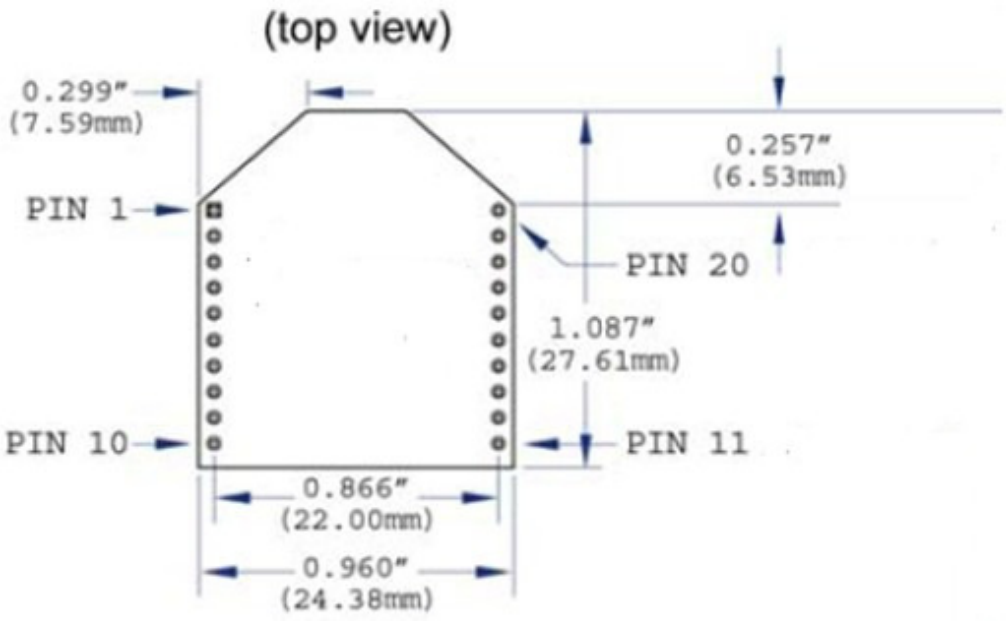
4) Module=UART_USB:

```
J7_1(X1) -> USB_GND
J7_2(X2) -> USBDP(+)
J7_3(X3) -> USBDM(-)
J7_4(X4) -> VBUS
J6_1(GD) -> GND
J6_2(TX) -> UART_TX  TTL
J6_3(RX) -> UART_RX  TTL
```

5 Interface Card Socket Definition and Layout

The pin layout of interface cards is compatible with Xbee module from Digi (www.digi.com). The socket on the Spyder motherboard can be used to receive any interface card with the pin out shown below:





Pin assignment of the interface card socket:

Pin #	Name	Direction	Description
1	VCC	-	3.3V Power supply
2	DOUT	Output	UART Data Out
3	DIN	Input	UART Data In
4	EX4	Depending on model of daughter card	Route daughtercard final interface signal back to mother board, and to the DIP pins to user's board
5	RESET	Input	Module Reset
6	EX3	Depending on model of daughter card	Route daughter card final interface signal back to mother board, and to the DIP pins to user's board
7	EX2	Depending on model of daughter card	Route daughter card final interface signal back to mother board, and to the DIP pins to user's board
8	EX1	Depending on model of daughter card	Route daughter card final interface signal back to mother board, and to the DIP pins to user's board
9	SLEEP	Input	Pin Sleep Control Line
10	GND	-	Ground
11	Unused	-	-
12	Unused	-	-
13	Unused	-	-
14	Unused	-	-
15	Associate	Output	Associated Indicator
16	Unused	-	-
17	Unused	-	-
18	Unused	-	-
19	Unused	-	-
20	Unused	-	-

Ⅲ Command Interface

1 Command Mode

1.1 Enter command mode

The module can be put into command mode by sending “+++” through serial port. The module will respond with an “ok”. In order to prevent the situation where the user data” +++”mistakenly triggers the command mode, there must be no serial port data input one second before and after the receiving of "+++". At the same time, the gap between the three”+” should not be more than one second, otherwise, it will be considered as a data rather than a command.

1.2 Exit command mode

There are two approaches to exit command mode. One way is to input command “ATEX”. The other is to timeout and automatically exit. In either case, the modules will response "exited". The timeout value can be set by command "ATTO"

2 Arguments and Responses

2.1 Arguments and Responses

For all the commands with arguments: if the parameters are correct, the module will respond with an “ok”. Otherwise, the modules will response with an “invalid para”. If there are no arguments associated with the commands, it will be treated as polling modem and the module will respond with the existing arguments residing in the module.

2.2 Commands without Arguments

There are four commands without arguments.

- + + +: enter command mode; will directly return “ok”.
- ATEX: exit the command mode, return “exited”.
- ATRS: software reset, will reset the module immediately, no return.
- ATSR: in search for other modules on the power lines, this will return the name of the found module. Please wait for two seconds after sending a command. The name of module received in two seconds will be shown in the serial port, otherwise, the name received after two seconds will be ignored. Note: In the course of searching, all bytes input from serial port also will also be ignored.

2.3 Modified arguments

Except for serial arguments, the modified arguments will be immediately saved into eeprom and take effect. The serial arguments won’t take effect immediately after being modified to avoid user from modifying PC serial arguments before inputting command. Serial arguments will take effect through automatically resetting module when exiting the command mode.

3 Command List

Command	Description	Arguments	Description	Default
Control Class				
+++		none	Enter command mode	

ATEX	Exit	none	Exit command mode	
ATTO	Time out	1-30	Timeout value, unit: second	5
ATRS	Reset	none	Software reset	
ATWT	Save to flash memory control	Y,N	This controls if the following setting will be saved to flash: ATDA ATNA ATDT ATRT ATWT itself is not saved to flash.	N
Network class				
ATDA	Domain Address	1-32767	Domain Address of Logic Address	1
ATNA	Node Address	1-65535	Node Address of logical address	1
ATDT	Packet Destination Serial Number (Physical Address)	0-2147483646	When set to 0, the packet will be broadcasted in the same logical domain. Otherwise, the packet will be sent to the node with the specified physical address (serial number).	0

Function class				
ATRP	Repeater	Y,N	Relay function, Y is on, N for off	Y
ATRT	Repeater Threshold	0- 32708	When the received signal strength is below this threshold and the repeater function is enabled, the packet will be repeated.	1023
ATRR	Remote Repeater	Y,N	Turn on the repeater function remotely. It may be set broadcast or individually depending on the ATDT settings.	Y
ATNM	Name	A string with length less than 15	Set the name of the module	PU-R485A
Communication class				
ATBD	Baud Rate	1200, 2400, 4800, 9600, 19200	Baud Rate	9600
ATDB	Data Bit	5,6,7,8	Data bit	8
ATPA	Parity	N, O, E	Parity bit，N = no, O = odd , E = even	N

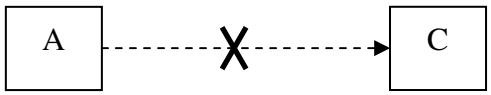
ATST	Stop Bit	1,2	Stop bit	1
Debug class				
ATRW	Raw	Y,N	The raw data for debugging. The module will output sent raw packets from host to the module, and not just the payload. Y means turn on this function, N means turning off.	N
ATSR	Search	none	Search for peer module on the power line network	

Ⅳ Repeater Function

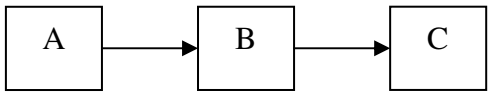
1 Introduction

To extend the coverage, Linksprite modules have built-in repeater function.

When the module's repeater function is turned on (off is the default setting), the module echos the data packet from the power line, while entertaining the data sent by host through the serial port.



Because of far distance, data transmission can not be reached.



After adding repeater function to proper locations, the data can be transmitted farther.

Transceiver function is not influenced by repeater function, that is to say, each module can be used as a separate repeater or can be seen as repeater when sending and receiving data. It can not only send and receive data from the power line, but also repeat other data packets.

In order to prevent network congestion, the module is smart smart enough to know the data were sent or repeated by itself and will discard the data packets when receiving the duplicated ones.

Note: Due to the fact that repeaters will resent the received data packets,

if the number of repeater is too large, a number of repeaters will seize the channel, and lead to increased communication time. When deploying the repeater, one should take full account of the balance of reliability and real-time.

2 Function Setting

AT command 'ATRP' is designed to set up the repeater function.

2.1 Turn on repeater function

Steps	input	response	description
1	+++	ok	Enter command mode
2	ATRP	Y or N	Poll current repeater status, Y is on, N for off
3	ATRP Y	ok	Turn on repeater function
4	ATRP	Y	Check present repeat status, ON
5	ATEX	exit	Exit command mode

2.2 Turn off repeater function

steps	input	response	description
1	+++	ok	Enter command mode
2	ATRP	Y or N	Check current repeater status, Y is on, N for off
3	ATRP N	ok	Turn off repeater function
4	ATRP	N	Check current repeater status, OFF
5	ATEX	exit	Exit command mode

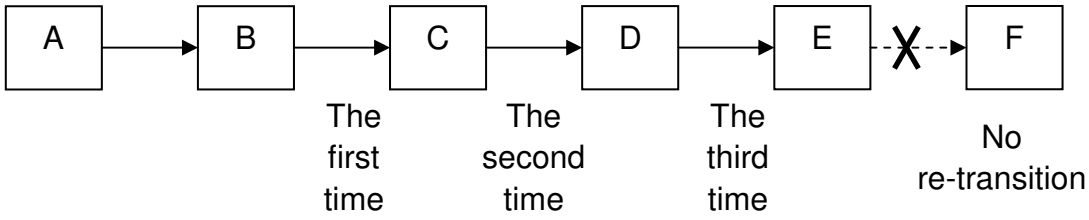
2.3 Setting Illustration

●Repeater function is available in the factory.

●Once repeater function is modified; it will immediately take effect and be preserved permanently, even if the module is restarted.

3 Repeater Hops

A data packet could at most pass through third repeater three times. It is shown as follows：



Data packet is sent from module A to module B. From module B to module C is the first time, to module D is the second time, and to module E is the third time. Module F is the termination. Therefore, data packet won't be sent to module F.

Ⅴ Logic Address

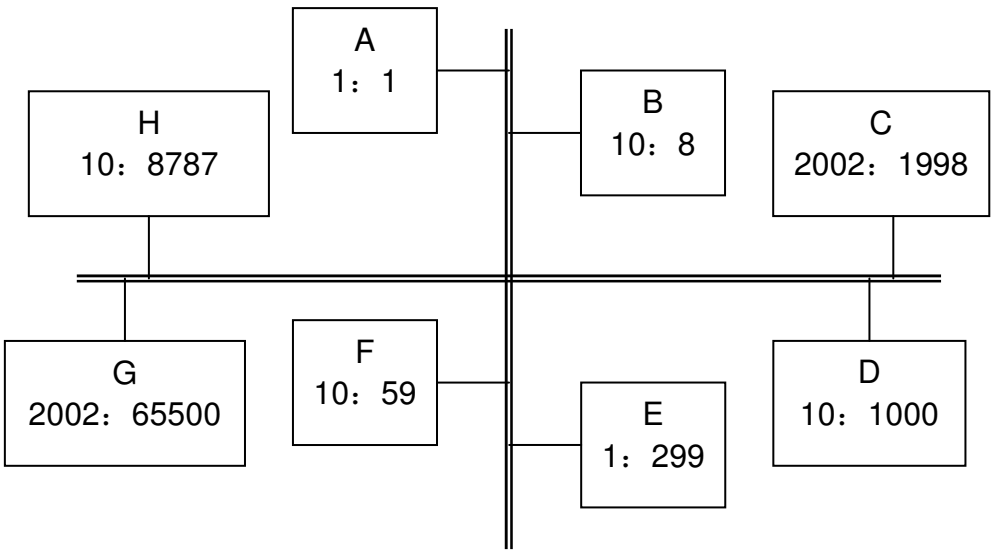
1 Logic Address

Module data packets are transmitted in the way of broadcasting in power lines. All modules will receive the data packets issued by the module and sent them, through the serial port under carrier signals area.

When multiple modules are installed on the same power line network, however, one does not want them to communicate directly; thus, the networks can be addressed by the logic address.

Logic address is composed of two parts: domain and nodes. For example, the logic address (10:200) means that the domain value is 10, node value is 200. Logic address is the default setting (1:1).

Module data packets can only be received and processed by the module at the same domain. Other modules, even detecting the carrier signal will not receive, nor to transmit to the serial port or repeater.



On the above figure, A, E are at the same network, their domain values are 1; B, D, F, H are at the same network, its domain values are10; C, G are at the same network, their domain values are 2002. Although in the physically speaking, all the modules are in a power line network, the packet issued by A, will only be received and processed by E, other modules will not respond. Similarly, packet issued by F, only B, D, H will receive and process packet issued by F, other modules will not work.

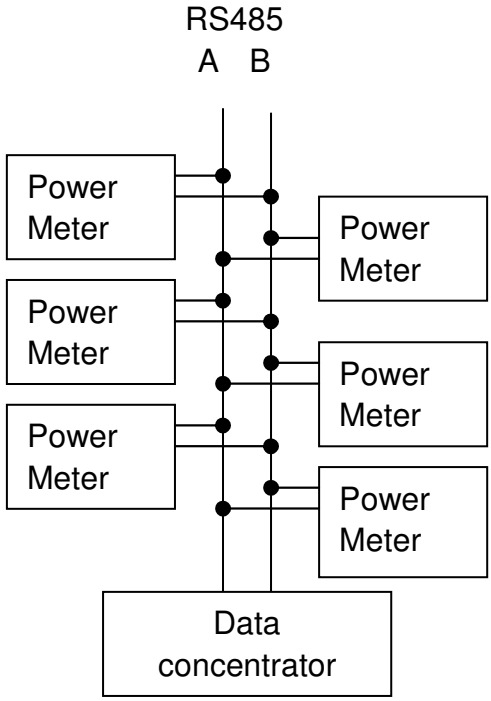
2 Address Setting

step	input	response	description
1	+++	ok	Enter command mode
2	ATDA	1-32767	Check domain values of present logic address. Default factory setting is 1.
3	ATNA	1-65535	Check nodes values of present logic address. Default factory setting is 1.
4	ATDA 2	ok	Set domain value of logic address as 2
5	ATNA 45	ok	Set nodes of logic address as 45
6	ATDA	2	Check domain values of logic address
7	ATNA	45	Check node values of logic address
8	ATEX	exited	Exit command mode

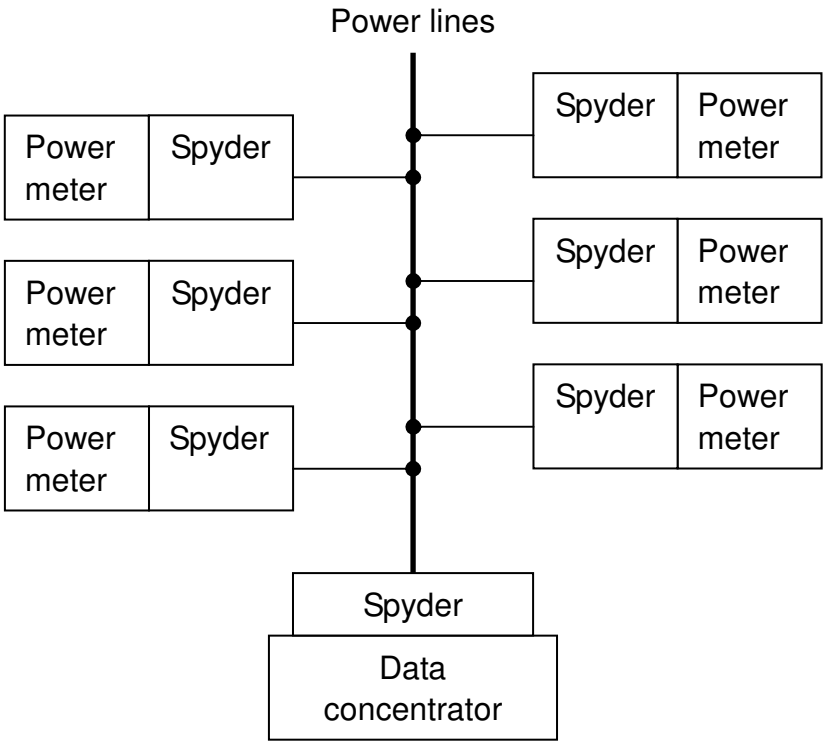
Ⅵ Application Illustration

1 Introduction

Intelligent instruments widely adopt RS485 bus to communicate. For example, the power meter automatic meter reading systems, data concentrator through the RS485 bus read the message from power meter.



In order to automatically meter reading, RS485 bus needs to be deployed. Here, using Spyder module, one can use the existed power lines to directly complete data transmission.


Power lines
Power meter
Spyder
Power meter
Spyder
Power meter
Spyder
Spyder
Power meter
Spyder
Power meter
Spyder
Power meter
Spyder
Data concentrator

2 Quick Start of Spyder

What you will need

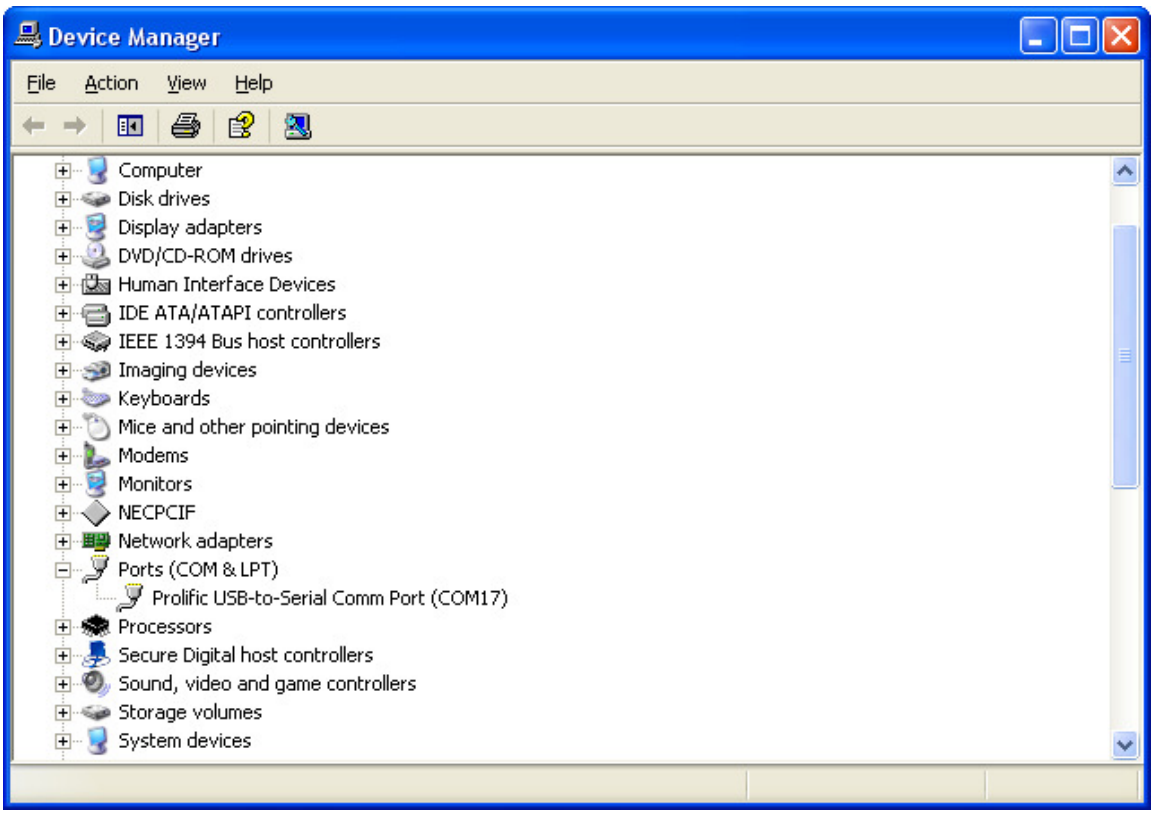
You need to have a pair of the items shown above:

1. Spyder
2. RS232 card or USB card
3. Power line cable used to couple power communication signal to power line, the power line can be 110V/220V 50/60Hz, DC, or unpowered.

4. 110V/220V to 12V/500mA power supply

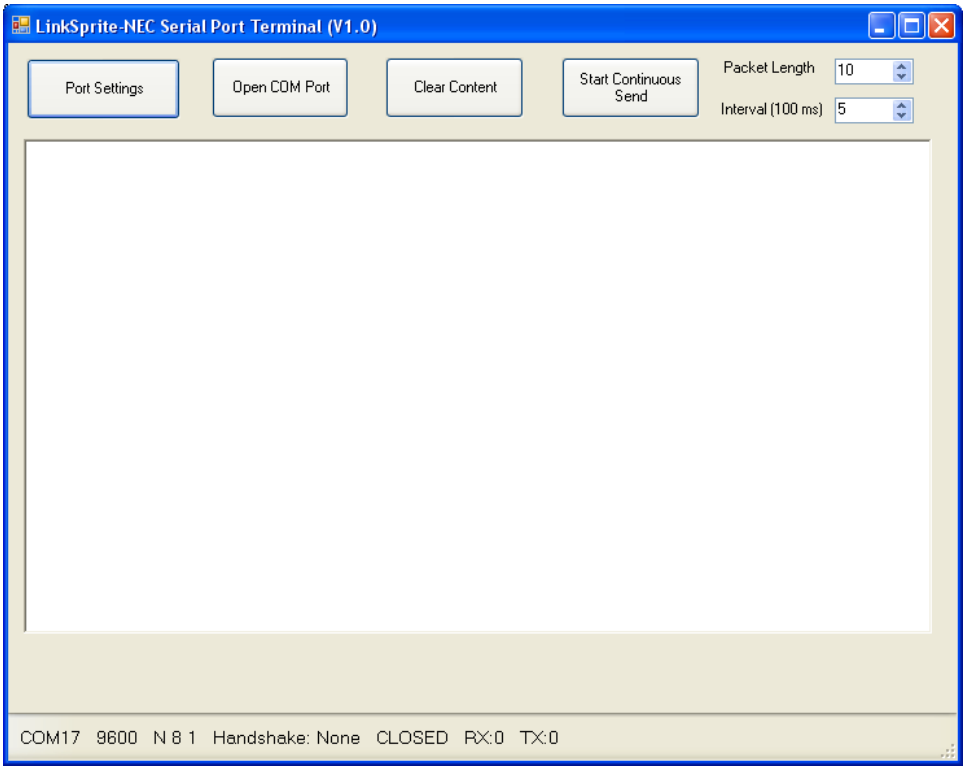
You need to install LinkSprite-NEC serial port terminal software that is included in the CD that accompanies the Spyder by clicking setup.exe

If you are using a USB to RS232 converter, you can use Device Manager tab to find out the COM port.

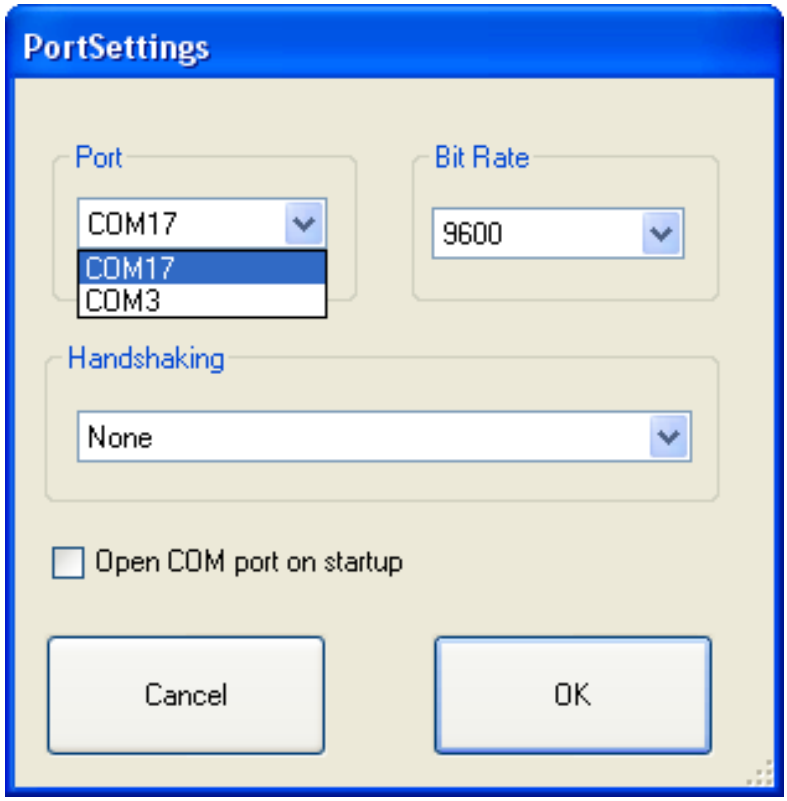


Open LinkSprite-NEC serial port terminal by click program and follow the following:

LinkSprite-NEC serial port terminal will show up as:



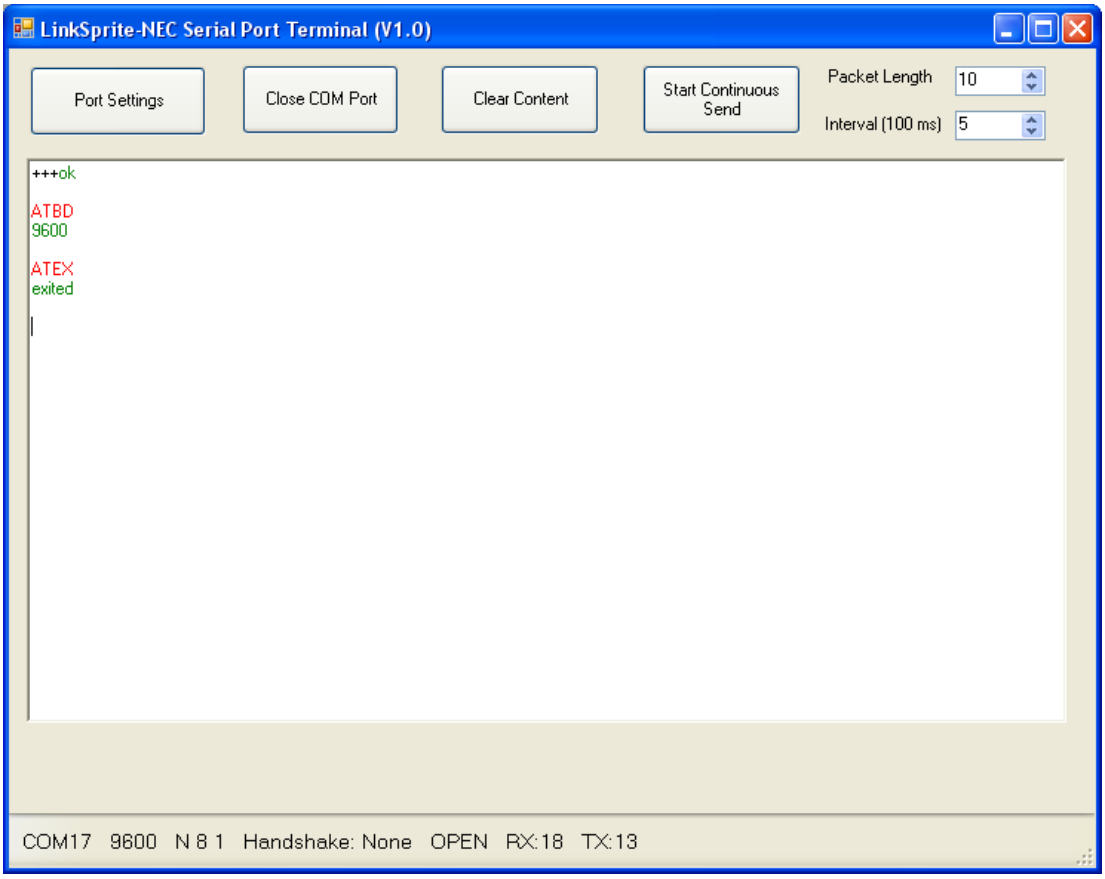
Click the “Port Settings” button to configure the serial port:



From device manager, we know that the COM port we are using is

COM17. The default baud rate for Spyder is 9600. Click “OK”, and Click “Open COM Port” to open the COM port.

As shown in the following screen, by typing three ‘+’ fast, we can enter into AT command mode to configure the module.



Next we can click “Start Continuous Send” to toggle continuous send and receive.